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3D printing - The merits for research, conservation and presentation

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INTRODUCTION

The development of technology and the augmenting digitization of global culture have resulted in a changing society: we deal with lots of fragmented and incoherent information, with various cultures, different social perceptions and with more replicas, reproductions and converted representations of original artworks than ever. Moreover, more reproduction techniques have entered contemporary culture, cultural institutions and the art world: we have the possibility to three-dimensionally (3D) print objects, preserving their visual and material qualities. Although we are used to seeing reproductions of artworks everywhere (in books and catalogues, via mobile devices, on posters or tourist miscellanea, and from canvas sneakers to coasters) 3D printing provides a totally new dimension to artworks. The ease to reproduce countless highly detailed one-to-one size copies of artworks and the way it discloses original artworks — both in physical and digital form— profoundly disrupts the modernist idea of the unique artwork, the idea that authenticity can only be attributed to the one and only original.

AIM

The aim is to show how 3D printing and future reproduction technologies can be implemented as useful and durable tools in overcoming conflicting perceptions of authenticity and to unify the fields of cultural heritage research, conservation, presentation and creation. It will provide various directly adaptable and sustainable 'hands-on' techniques - derived from case studies - of implementing technology and reproduction, facilitating engagement between visitor and cultural heritage in a way that is in line with institutional goals and the needs of society now and in the future.

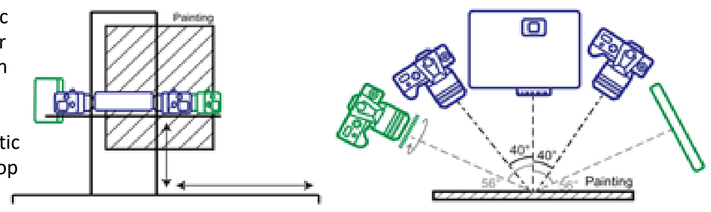
METHOD

Over the course of this investigation, there will be a constant fine-tuning between theory and practice, as this research will both be executed through literature research as well as by practice based testing and co-operation with museums and cultural institutes. The paintings that will be used as case studies will be scanned by using Colour, Gloss, Topography imaging (CGT) scanning developed by Delft University of Technology; the 3D prints will be made by Océ Technologies. By working closely with the conservation professionals of the Netherlands Institute for Conservation+Art+Science and Stichting Restauratie Atelier Limburg, museums throughout the Netherlands and by using the paintings in their collections as case studies (e.g. Saul & David) theory is put into practice.

The scanning technology CGT consists of two integrated modules, one capturing the topography (and colour) and the other capturing spatially-varying gloss. The topographic scanning module uses two cameras, mounted at 40° angles relative to the painting's surface normal), to triangulate the surface topography. The light source is a projector which illuminates the surface, positioned parallel to the painting's surface. Surface reflections are filtered by the cross-polarised setup of the illuminant (projector) and cameras. After processing, the resulting heightmap can be visualised 'as-is', where the visualisation range is used to show complete height variation of the surface (i.e. the canvas bulging and losses). Furthermore, the lowest frequency can be filtered out, so that the data visualisation range can be used to better visualise the high-frequency variations of the surface (i.e. showing the canvas weave and crack pattern). The spatially-varying gloss is measured by utilizing the polarisation of reflectance. A LED-array source is placed at a 56° angle to the paintings surface normal and the surface gloss is recorded by a camera with a polarisation filter. Pictures are then taken with and without reflection of the surface. Gloss maps are generated and projected onto the topographical maps. These images are visualised in grayscale where, lighter regions signify higher glossiness.

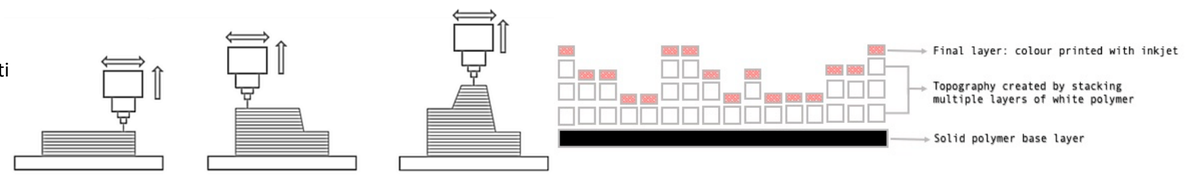
To 3D print a painting, rapid prototyping and stereo lithography (SLA) are used. The technique used to reproduce paintings is slightly different from 3D printing three-dimensional objects, because texture is printed on a flat polymer base. As this printing technology does not printa three-dimensional object but a textured layer, it is referred to as 'elevated printing'. The layers that are used to create texture are uniform and monotonous. Only the final layer is printed in colour with an inkjet printing system (CYMK). The end result is a three-dimensional polymer print of a painting including all its textural characteristics and its aesthetic qualities.

Left: Schematic of CGT scanner front view with the x-axis and y-axis
Right: Schematic CGT scanner top view



Left: Additive manufacturing

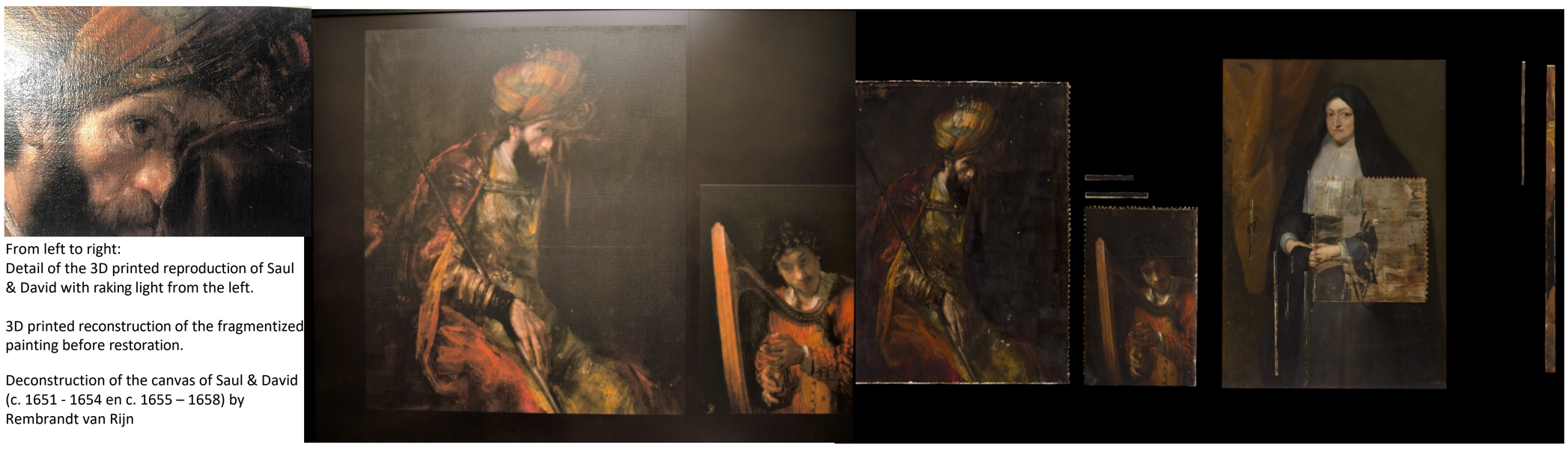
Right:Construction of a printed painting using elevated printing



EXAMPLE: THE CASE OF SAUL & DAVID

In 2015, the Mauritshuis in The Hague hosted the research project and exhibition *Rembrandt? The Case of Saul & David.* Rembrandt van Rijn's *Saul & David* (1651–1655 & 1655–1658) was sawn into pieces and its original material became fragmented (Fig 1.). It was in need of thorough restoration and it was unclear whether or not this painting really was made by Rembrandt. 3D printing was used to scan the surface of the painting and to discover the original composition and size of the painting (Fig. 2 & 3).

- Technical art historic research: the topographic scanning and the reconstruction were useful in determining that this painting can be attributed to Rembrandt van Rijn;
- Painting conservation: 3D printing helped in conserving the painting in its complete composition;
- Presentation: the 3D print was on display before the original's restoration was completed and the 3D print allowed visitors to touch and feel Rembrandt's technique and brushstrokes, adding a new dimension. Later both were displayed next to each other.



From left to right:
Detail of the 3D printed reproduction of Saul & David with raking light from the left.

3D printed reconstruction of the fragmentized painting before restoration.

Deconstruction of the canvas of Saul & David (c. 1651 - 1654 en c. 1655 – 1658) by Rembrandt van Rijn

FUTURE OPPORTUNITIES

- In this case, the conservators chose to keep the painting intact and in its complete composition. The 3D print could provide a way to display the painting in fragments as shown in Fig 1. This could attribute to knowledge about the painting's turbulent history and in terms of presentation, this could provide an interesting narrative.
- Color and texture reconstruction can be implemented and visualized with 3D printing, which could potentially provide interesting knowledge about the painting, the materials and the artist, without having to interfere with or damage the original's materiality. The use of topographic scanning and 3D printing can result in a better understanding of the artwork and consequently, in a better conservation or restoration treatment.

CONTACT

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